SYNOPSIS

of the thesis to be submitted for the

Degree of Doctor of Philosophy

in Botany

Faculty of Science,

Swami Ramanand Teerth Marathwada University, Nanded

Topic

"STUDIES ON RIPARIAN FLORA OF NANDED DISTRICT (M.S.), INDIA"

Submitted By

Mr. Ashish Sudarshan Bharti

(M. Sc. (Botany), B. Ed., SET, PET)

Email ID: abharati358@gmail.com

Mobile No.: **7775848212/ 9284274481**

Supervisor

Dr. V. R. Marathe

Associate Professor,

Department of Botany,

N. E. S. Science College, Nanded (M.S)

Email: dr.vishalmarathe@gmail.com

Mobile No: 7588565395

December, 2024

“STUDIES ON RIPARIAN FLORA OF NANDED DISTRICT (M.S.), INDIA”

1. INTRODUCTION: -

The word **“**riparian” originates from the Latin term *ripa*or*riparius*, meaning "bank" or "shore," particularly of a river or stream (Junk & Piedade, 1997). The English adjective *riparian* began to be used in the 19th century to denote things associated with riverbanks, such as vegetation, habitats, or legal rights pertaining to land adjacent to rivers. The riparian zone is identified as the area immediately adjacent to running or fresh water. The riparian zone is the area where aquatic systems meet terrestrial environments, often referred to as gallery forests or streamside forests. (Brinson, 1990).

Riparian vegetation is often referred to as a "keystone ecosystem" because it supports distinctive habitats that are profoundly shaped by the presence and dynamics of water. (Goebel et al., 2003; Sunil et al., 2016).Rivers are important for human civilization in many ways, including providing water, habitat, and transportation etc. Riparian flora, or vegetation along the banks of rivers is also important for many reasons. Riparian vegetation helps to regulate water quality; it also prevents riverbank erosion. It supports aquatic and terrestrial food webs by maintaining biological diversity. These areas provide specialized habitats and are areas of unique ecosystem functions. Riparian zones support a unique variety of plant species that serve critical ecological, hydrological, and socio-economic functions. (Naiman et al., 1993; Vyas et al., 2012).

The documentation of riparian flora plays a pivotal role in understanding, preserving, and managing riparian ecosystems. Proper documentation and research are necessary to gain insights into the current state, threats, and management needs of these areas. Researchers can measure the richness, variation, and scarcity of plant life in riparian zones by documenting the species that live there. This is especially crucial for recognizing species that are endangered or threatened and must be protected (Zedler 2000). Conserving riparian flora (the vegetation along riverbanks, streams, and other water bodies) is crucial for maintaining ecosystem health and addressing environmental challenges.

Study area:

The Nanded is the district headquarter in Marathwada region of Maharashtra state located in west-central India. Nanded district is bordered by Yavatmal district to the north, Parbhani and Hingoli districts to the west, Latur district and Bidar district of Karnataka to the south, and Nizamabad, Medak, and Adilabad districts of Telangana to

the east. This positioning places Nanded at the intersection of multiple state boundaries, highlighting its geographical significance for ecological diversity, cultural interactions, and regional connectivity.The district spans an area of approximately 10,528 square kilometers, with a population density of 319 individuals per square kilometer. It is administratively divided into 16 talukas, reflecting its significant geographical and demographic diversity.

The district experiences a predominantly dry climate, except during the monsoon season, when it receives about 89% of its annual rainfall from the southwest monsoon. Rainfall increases progressively from west to east, with an average annual range of 767 to 1,285 mm spread over approximately 47 rainy days. Temperatures in the district vary significantly throughout the year, with a mean daily maximum temperature of 42°C in May and a mean daily minimum temperature of 13.1°C in December. These conditions reflect the district's semi-arid climate, influenced by seasonal variations.

The primary rivers in the district include the Godavari, Painganga, Manjara and Manar (https://www.mapsofindia.com, 2023). The Godavari River is the second largest river of India and flows for approximately 140 kilometers within the district and is joined by three tributaries: Asna, Sita, and Sidha. The Manjara River forms the southeastern boundary of the district for about 40 kilometers and has two

triburatiesnamely Manar and the Lendi. The Paingangariver forms the northern boundary of the district and flows from west to east. These rivers play a significant role in shaping the geography and ecology of the region.

Nanded district has an extensive river network. This rich aquatic ecosystem makes the study of its riparian flora essential to bridge gaps in knowledge and provide baseline data for regional and national conservation strategies. It will contribute to broader databases, such as those maintained by the Indian Biodiversity Portal, and align with national efforts to conserve biodiversity under frameworks like the National Biodiversity Action Plan.

2. REVIEW OF LITERATURE & DEVELOPMENT IN THE SUBJECT(Previous work done in the relevant area):

The significant work has been done on the documentation of the floristic diversity of the Marathwada region, primarily by botanists focusing on taxonomy, ecology, and the identification of previously unrecorded species. The well-known "Flora of Marathwada" which serves as a foundational reference for plant taxonomy and diversity in the region (Naik, 1998). Apart from this work various researchers reported additions to the flora of Marathwada, documenting number of flowering plant taxa previously unrecorded in the region (Bhosale et al., 2017; Gaikwad et al., 2014; Sardesai and Dhabe, 2013). Documentation of riparian vegetation is much more neglected not only in Marathwada region but also at Maharashtra state level.

Mohite and Samant (2013) investigated the status of riparian ecosystems in the Panchaganga River System (PRS) in Kolhapur district, highlighting threats like deforestation, mining, agricultural expansion, and industrial pollution. The study noted that habitat degradation due to river valley projects, water level fluctuations from dams and exotic fish species have significantly impacted biodiversity. Conservation measures were recommended to mitigate these cumulative impacts.

Mane (2014) examined the diversity of aquatic macrophytes and hydrochemistry in the Godavari River within Nanded district, recording 30 macrophyte species from various sites.

Mohanan P et.al., (2020) conducted a comprehensive study on the medicinal plants of the riparian zone along the Chaliyar River in Kerala, documenting 106 plant species from 48 families, with *Asteraceae*, *Euphorbiaceae*, and *Malvaceae* being predominant.

Patel et al. (2020) documented the diversity of angiospermic plants in the estuarine and riparian zones of the Sabarmati and Mahi rivers in Gujarat, recording 40 species from 26 families. The study highlighted ecological adaptations, with species categorized as halophytes, hydrophytes, mesophytes and xerophytes, underscoring the ecological significance of these zones for plant diversity.

Karthika et al. (2020) documented the riparian vegetation of *Mylaudy Panchayath* in Kanyakumari, Tamil Nadu, reporting 79 species of flowering plants from 66 genera and 26 families. Their study highlighted the dominance of herbaceous plants, particularly *Cynodondactylon*, *Euphorbia hirta*, and *Tridax procumbens*, which are commonly found in the area. The research also noted the presence of several invasive weed species and emphasized the importance of conservation to preserve the region's biodiversity and ecological balance.

Dhivya and Kalaichelvi (2017) conducted a comprehensive study on the riparian vegetation along the Bhavani River in the Pillur Beat, Karamadai Range, Western Ghats, Tamil Nadu. Their research reported 112 plant species from 72 genera and 43 families, with trees being the most prominent group. The study identified *Terminalia arjuna* and *Pongamia glabra* as the dominant tree species, and leaves were found to be the most commonly used part for medicinal purposes. The findings emphasized the importance of developing and implementing conservation plans tailored to the riparian ecosystem.

Dhara et al., 2015 conducted a study on Riparian vegetation of Mini River in Vadodara, Gujarat and recorded 91 plant species belonging to 79 genera and 36 families. This study provides the first baseline data on the vegetation character of the riparian zone of Mini River and calls for its conservation and restoration.

Gitte et al. (2012) conducted an ethno-medicinal survey in Marathwada from 2009 to 2012, documenting the traditional use of plant barks in treating various ailments. Medicinal plants such as *Acacia nilotica*, *Azadirachta indica*, *Albizia lebbeck*, and *Aegle marmelos* were identified as having significant therapeutic value. The study emphasizes the importance of preserving traditional knowledge and exploring the pharmacological potential of these plants for sustainable use.

Reddy et al. (2015) explored the traditional uses of plants in Mahur Taluka, Nanded district, highlighting the rich ethnobotanical knowledge of local communities. The study documented 36 plant species from 25 angiospermic families,

Ethnobotanical survey was conducted by Rathi et al., (2020) to document the medicinal plants used by the tribal people of Wardha District, Maharashtra. The study identified 65 plant species from 46 families, exploring their medicinal applications and preparation methods.

By documenting the riparian vegetation of the Nanded district, this study will contribute to ongoing national and regional efforts to conserve riparian zones, filling existing gaps and supporting sustainable management of river ecosystems.

3. OBJECTIVES OF RESEARCH/ PROPOSED HYPOTHESIS:

Main objectives of present research work are as

1) To studythe riparian vegetation with special reference to Angiosperm plants diversity of the study area in Nanded district.
2) To document the Ethno medicinal importance of riparian flora from local, tribal people and herbal practitioners of study area in Nanded district.
3) To find out the Impacts/Threats to the riparian vegetation and their mitigation measures.

4. METHODOLOGY TO BE ADOPTED:

Phase I: Documentation of Riparian vegetation

Extensive field surveys will be carried out along the water bodies, lakes, ponds and rivers of Nanded district to document the riparian vegetation with special reference to the angiosperm plants.The survey of riparian vegetation will be made by frequent seasonal visits in different regions of Nanded district (Kothari, 2004). Literature survey will also be done to know the plant diversity of the study area. The plant species will be collected during the field trips and will bring to laboratory. Species will be identified using Standard floras (Cooke, 1967; Naik 1998; Sharma et.al.1996;Yadav and Sardesai, 2002).Herbarium specimens will be prepared.

Phase II: Documentation of Ethno medicinal Information:

During the field surveys ethno medicinal information of plants will be collected from local, tribal people and herbal practitioners from study area and information available in the literature. A survey sheet/data sheet/enquiry sheet will be carefully prepared for documentation. Field trips will be made with the local informants to observe the ethno medicinal plants in nature. Locals or tribal will be interviewed in most formal way. Personal details about informants will be also entered on data sheet. Information like the name (common/vernacular/ local name) of plant, the parts used as ethno-medicine and the mode of use will be noted down.

Phase III: Data Analysis and Interpretation:

Analysis of total plant species documented to find out the Invasive alien species, endemism, IUCN threatened category taxa of riparian flora in the study area. List out the Impacts/Threats to the riparian vegetation in the study area and suggestions will be given for their mitigation measures.

5. IMPORTANCE OF STUDY/ SOCIETY APPLICATION:

- **International status:**

The documentation of riparian flora has gained attention internationally due to the critical role riparian zones play in maintaining ecological balance, biodiversity, and water quality. In many countries, studies and conservation efforts have focused on understanding the vegetation and ecological functions of riparian zones, particularly in regions facing biodiversity loss or environmental degradation.

Research on the documentation of riparian flora has been conducted in various countries, reflecting its ecological significance and regional biodiversity. In the U.S., studies often emphasize riparian buffer zones' role in water quality and habitat conservation. European studies have explored riparian flora's distribution and its relationship with climate and hydrological factors (Alessia, 2012).

Riparian vegetation in Australian river systems, such as the Murray-Darling Basin, has been studied to understand its resilience to flooding and drought (Webb, 2003). In Japan, research has examined the dynamics and mechanisms that govern the coexistence of riparian tree species, tree demography, the response to water stress of trees, and the conservation of endangered species (Sakio and Tamura, 2008).

Studies in African rivers and canal, have focused on the role of riparian flora in supporting local livelihoods and biodiversity (Ahmed et al., 2019). Research in the Amazon Basin has emphasized riparian zones as biodiversity hotspots, documenting the composition and conservation needs of these habitats in light of deforestation and climate change (Melo et. al., 2018).

The study on Floristic Characteristics of Riparian Pan Vegetation from the Ndumo Game Reserve, South Africa provided a baseline data set by which future changes in the specific floristic characteristics (species composition, structure, cover and density) (Whittington et al., 2016).

Restoration projects aimed at improving riparian vegetation have been implemented in countries like Australia, Canada, and the USA, focusing on enhancing

river connectivity and improving habitat quality. These efforts underline the importance of riparian zones in controlling soil erosion, providing habitats for diverse flora and fauna, and supporting local communities (Feio et al., 2021).

The international research highlights the diverse roles of riparian flora, from water quality management and habitat provision to their cultural and economic importance. Each region's focus varies based on its ecological and socio-economic priorities, showcasing the global relevance of riparian ecosystems.

- N**ational Status:**

Documentation of riparian flora contributes significantly to understand role of ecosystem in ecological resilience and addressing conservation challenges in the aspect of anthropogenic threats. The Botanical Survey of India (BSI) has been a key institution documenting India's floristic diversity, including riparian flora, through regional floras and specific studies. For instance, Flora of India Series includes many floras, like *Flora of Maharashtra* (Singh et al., 2001), include descriptions of riparian vegetation. The BSI has also documented wetland flora in riparian ecosystems.

Various researchers work on riparian vegetation especially in biodiversity-rich zones like the Western Ghats (Bachan, 2010, 2022) and the Himalayas (Balunietal., 2022, Gaur, 1999, Sharma et al., 2022). Riparian vegetation along major river systems like the Ganga (Rana et al., 2023), Sabarmati river, Gujrat (Parmar et al., 2021), Vamanapuram River Basin (VRB), Kerala(Vincy & Brilliant, 2024) has been explored.

Western Ghats, and Indo-Burma regions, have received significant attention in riparian biodiversity studies. However, riparian vegetation in peninsular India, including central and southern rivers like the Godavari, remains relatively underexplored. Riparian flora of Maharashtra, especially along major rivers like the Godavari, Tapi, and Krishna, has been sporadically documented. Flora of Marathwada (Naik, 1998), this regional flora includes many riparian plant species found in the Marathwada region of Maharashtra state.

- **Significance of the study:**

Riparian vegetation, the green corridors along riverbanks, lakes, ponds and water bodies, plays a pivotal role in maintaining the ecological health of aquatic and terrestrial ecosystems. The study of riparian vegetation in the Nanded district, with a focus on angiosperm plant diversity, holds both regional and broader ecological importance. The study of riparian plant diversity holds immense ecological, social, and scientific value in the study area.

This study is important for the biodiversity conservation, ecosystem stability, and sustainable development. This study will also be significant with respect to the use of the ethnomedicinal plants of local and tribal people of the study area. By understanding the complex relationships between plants, the environment, and human activities, this research can contribute to preserving riparian ecosystems and their vital functions for generations to come.

6.PROPOSED WORK PLAN/ FORMULATION AND STRUCTURE OF STUDY:(Year wise Plan of work and targets to be achieved)

Present research will be carried out in three years. Year wise plan of work is as follows:

Duration	Plant of work
First Year	Extensive Field and literature survey for the selection of study sitesin the Nanded district along with the documentation of riparian flora.
Second Year	Extensive Field surveys will be carried out to document the riparian angiosperm vegetation along the selected rivers, lakes and ponds of Nanded district. Documentation of Angiosperm riparian flora andstudy of their ethno-medicinal useswill be carried out. Plant collection and herbarium specimen preparation.
Third Year	Data analysis andinterpretation.Research paper publication. Preparation of final synopsis and thesis writing.

7. REFERENCES:

1. Ahmed Elkordy, Omer Elshikh& Naglaa Abdallah. (2019). Floristic diversity and vegetation analysis of riparian and aquatic plants of the canals in the Sohag Governorate, Egypt. *PhytologiaBalcanica*. Vol. 25(1): 81–95
2. Alessia Nucci, Claudia Angiolini, Marco Landi, Gianluigi Bacchetta. (2012). Regional and Local Patterns of Riparian Flora: Comparison Between Insular and Continental Mediterranean Rivers. *Ecoscience*. Vol. 19(3): 213-224
3. Bachan Amitha, K.H. (2010). *Riparian Flora of the Chalakudy River Basin and Its Ecological Significance*. Ph. D. Thesis, University of Calicut, Kerala, India
4. Bachan K.H. Amitha, S. Pooja, and M.A. Devikab. (2022). Riparian Forest of Western Ghats, an Endangered Ecosystem. *Imperiled: The Encyclopedia of Conservation*, Vol. 2: 100–113

5. Baluni, P., Kathait, P., Bahuguna, P., Kotnala, C.B. and Rayal, R. (2022). Analysis of riparian vegetation diversity at Khanda Gad Stream, Garhwal Himalaya, Uttarakhand, India. The Scientific Temper, Vol. 13(2): 180- 185.
6. Bhosale, S.S., Paithane V.A., Rathor B.M., Dhabe A.S. and Bhuktar A.S. (2017). Some newly introduced flowering Taxa in the Marathwada region of Maharashtra State, *India. Bioscience Discovery*, Vol. 8(2): 265-269
7. Brinson, M.M. (1990). Riverine forests. In: Lugo, A.E., Brinson, M.M. Brown, S. (Eds) *Ecosystems of the World-15: Forested wetlands*. Elsevier, Oxford. Pp.87-141.
8. Cooke T. (1967) (Rpr.). *The Flora of the Presidency of Bombay*. Vol. I, II, III. Botanical Survey of India. Culcutta.
9. Dhara R. Shah, Sumesh N. Dudani, Amita O. Sankhwal and Deepa J. Gavali. (2015). Riparian vegetation of Mini River in Vadodara, Gujarat. *International Journal of Environmental Sciences.* Vol. 6 (2): 307-317.
10. Dhivya, S. M., & Kalaichelvi, K. (2017). Riparian vegetation of River Bhavani, Pillur Beat, Karamadai Range, Western Ghats – An intensive assessment. *International Journal of Current Research in Biosciences and Plant Biology,* Vol.4(9): 66–78.
11. Feio, M.J.; Hughes, R.M.; Callisto, M.; Nichols, S.J.; Odume, O.N.; Quintella, B.R.; Kuemmerlen, M.; Aguiar, F.C.; Almeida, S.F.P.; Alonso-EguíaLis, P.; et al. (2021). The Biological Assessment and Rehabilitation of the World's Rivers: An Overview. *Water.* Vol.13, 371: 1-45.
12. Gaikwad, S.P., Gore R.D., Garad K.U. and Randive S.D. (2014). New plant records for the Marathwada region of Maharashtra, India. *J. Threatened Taxa*, Vol. 6(6): 5878-5886.
13. Gaur, R.D. (1999). *Flora of district Garhwal North Himalaya(with ethno-botanical notes)*. Transmedia, Srinagar (Garhwal).
14. Gitte, T. A., Kare, M. A., & Deshmukh, A. M. (2012). Ethno-medicinal studies on barks of some medicinal plants in Marathwada (M.S.), India – I. *Recent Research in Science and Technology,* Vol. 4(10): 8-10.
15. Goebel, P. C., B. J. Palik & K. S. Pregitzer. (2003). Plant diversity contributions of riparian areas in watersheds of the Northern Lake States, USA. *Ecological Applications*. Vol. 13: 1595-1609.

16. Junk, W.J., Piedade, M.T.F. (1997). Plant Life in the Floodplain with Special Reference to Herbaceous Plants. In: Junk, W.J. (eds) *The Central Amazon Floodplain. Ecological Studies*. Vol 126. Springer, Berlin.
17. Karthika, T., & Mary Kensa, V. (2020). Riparian flora of Mylaudy Panchayath, Kanyakumari district, Tamil Nadu, India. *AEGAEUM Journal,* Vol.8(11), 123-145.
18. Kothari C.R. (2004). *Research Methodology: Methods and Techniques*. 2nd Edition, New Age, New Delhi.
19. Mane, V. P. (2014). Ecology and vegetation of Godavari River in Nanded District, Maharashtra. *International Journal of Advanced Biotechnology and Research (IJBR),* Vol. 5(4), 784-789.
20. Melo Maria, Medeiros Raquel, Sampaio Paulo & Vieira Gil. (2018). Sustainability issues: Riparian vegetation and its importance in the hydrological cycle in Amazonian ecosystems. *Journal of Security and Sustainability*Vol. 7 (4). 861-868.
21. Mohanan, P., Anupriya, C. V., & Binu Thomas. (2020). Documentation of medico-potential plants in the riparian zone of Chaliyar River in Malabar region of Kerala, India. *International Journal of Botany Studies,* Vol. 5(6), 43–51.
22. Mohite, S. A., & Samant, J. S. (2013). Impact of land use changes on riparian habitats in Panchganga River System. *Dept. of Environmental Science,* pp 203-207.
23. Naik, V.N. (1998). *Flora of Marathwada*. Amrut Prakashan, Aurangabad.
24. Naiman, R.J., Décamps, H. and Pollock, M. (1993). The role of riparian corridors in maintaining regional biodiversity, *Ecological Applications*. Vol. 3(2): 209-212.
25. Parmar Rahul, Kuldip Purani, Lopamudra Das and R. D. Kamboj. (2021). Phytosociological Study of Riparian Flora of Sabarmati River in Prantij Taluka of Sabarkantha District, Gujarat, India. *International Journal of Creative Research Thoughts* (IJCRT). Vol. 9 (4): 5447 – 5455.
26. Patel, R. B., Tatu, K., & Kamboj, R. D. (2020). Diversity of angiospermic plants in estuarine and adjoining riparian areas of Sabarmati and Mahi rivers, Gujarat, India. *International Journal of Scientific Research in Science, Engineering and Technology.* Vol. 7(6): 116–124.
27. Rana K. K., Rajesh Rayal, Pankaj Bahuguna, Pratibha Baluni and Anita Chauhan. (2023). Riparian Vegetation Along River Ganga Near Haridwar City And Its Role In The Presence And Community Structure Of Aquatic Mites. *J. Mountain Res.* Vol. 18(2): 121-131.

28. Rathi, B., Khobragade, P., Rathi, R., & Gupta, R. (2020). Ethno-botanical survey on medicinal plants used by tribes of Karanja (Ghadge) Tahsil of Wardha District, Maharashtra, India. *Int. Journal of Ayurvedic Medicine,* Vol.12(1): 43–52.
29. Reddy, E. S., Dinesh, V., Suvarna, P., &Bembrekar, S. K. (2015). Traditional uses of plants in indigenous folklore of Mahur Taluka, Nanded District, Maharashtra, India. *Indian Streams Research Journal,* Vol. 4(12): 1-5.
30. Sakio Hitoshi and Toshikazu Tamura. (2008). *Ecology of Riparian Forests in Japan: Distribution, Life history and regeneraton.* Springer-Verlag Tokyo
31. Sardesai, M.M. and Dhabe A.S. (2013). A catalogue of species added to the flora of Marathwada. *Bioinfolet-A Quart. J. Life Sci*., Vol.10(1a): 1-7.
32. Sharma B. D., S. Karthikeyan, and N. P. Singh. (1996). *Flora of Maharashtra state, Monocotyledons*. Botanical Survey of India. Calcutta.
33. Sharma, N., Rayal, R., Chamoli, K.P., Bahuguna, P. and Baluni, P. (2022). Observation on the Diversity of Riparian Vegetation in Sahastradhara Stream from Doon Valley (Uttarakhand) India. *The Scientific Temper*, Vol. 13(1): 37-45.
34. Singh, J.S., & Singh, S.P. (2017). Biodiversity and Ecosystem Services in Riparian Zones of Ganga Basin. *Current Science*, Vol.112(6): 1105-1111.
35. Singh, N.P., Lakshminarasimhan, P., & Karthikeyan, S. (2001). *Flora of Maharashtra State*. Botanical Survey of India, Kolkata.
36. Sunil, C., Somashekar, R. K. and Nagaraja, B.C. (2016). Diversity and composition of riparian vegetation across forest and agroecosystem landscapes of river Cauvery, southern India. *Tropical Ecology*. Vol. 57(2): 343-354.
37. Vincy M. V. and R. Brilliant. (2024). Assessing Riparian Floristic Diversity and Vegetation Dynamics in the Vamanapuram River Basin, Kerala: A Comprehensive Analysis. *Nature Environment and Pollution Technology*. Vol. 23 (2): 695-710)
38. Vyas, V., Kumar, A., Wani, S.& Parashar, V. (2012). Status of Riparian Buffer Zone and floodplain areas of River Narmada. *Int. J. Envir. Sci*. Vol. 3(1): 659-674.
39. Webb, Ashley A. and Wayne, D. Erskine. (2003). A practical scientific approach to riparian vegetation rehabilitation in Australia. *Journal of Environmental Management.*Vol. 68: 329–341
40. Whittington M., M.D. Panagos and G. Malan. (2016). Floristic Characteristics of Riparian Pan Vegetation from the Ndumo Game Reserve, South Africa. *The Journal of Animal & Plant Sciences*, Vol. 26(2): 445-456

41. Yadav S. R. and M. M. Sardesai. (2002). *Flora of Kolhapur District.* Shivaji University, Vidyanagar, Kolhapur – 416 004.
42. Zedler B. (2000). Progress in wetland restoration ecology. *Trends in Ecology & Evolution*. Vol. 15 (10): 402-407.

Research Student | Supervisor

(Mr. Ashish Sudarshan Bharti) | **(Dr. V. R.Marathe)**